

June 27, 1939.

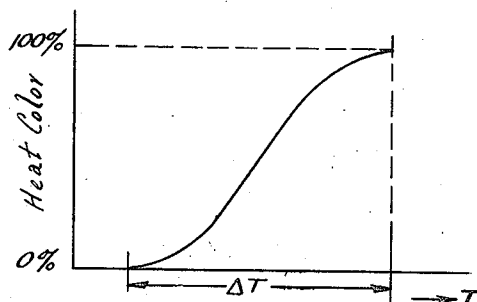
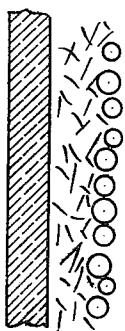
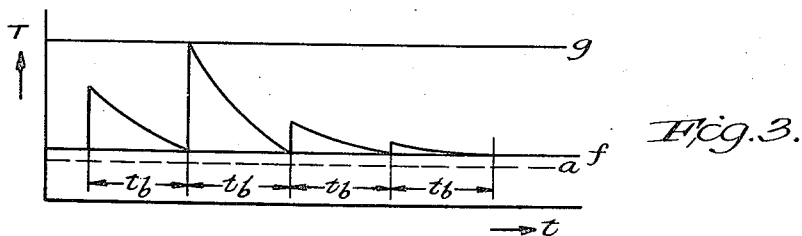
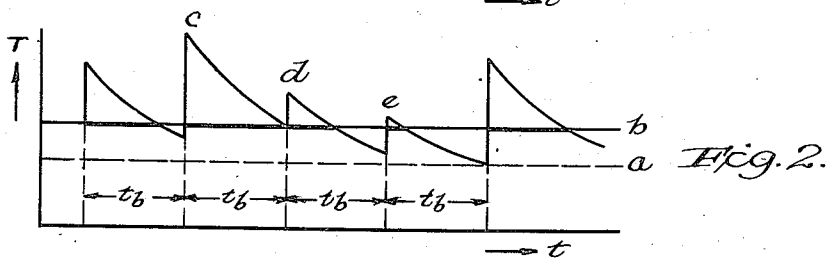
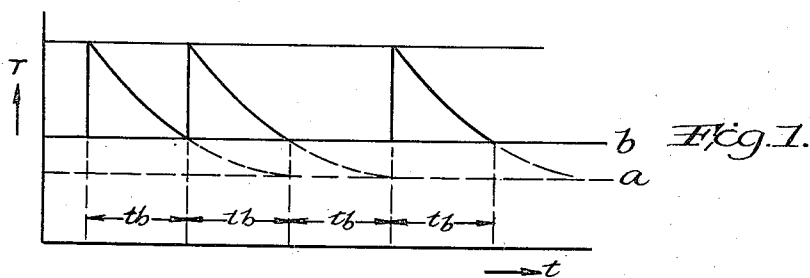
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2,163,918

IMAGE SCREEN FOR BRAUN TUBES

Filed June 6, 1936

2 Sheets-Sheet 1



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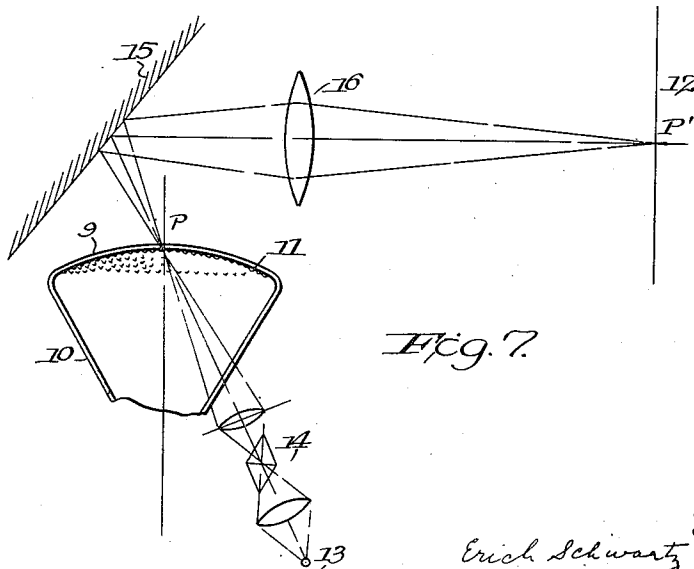
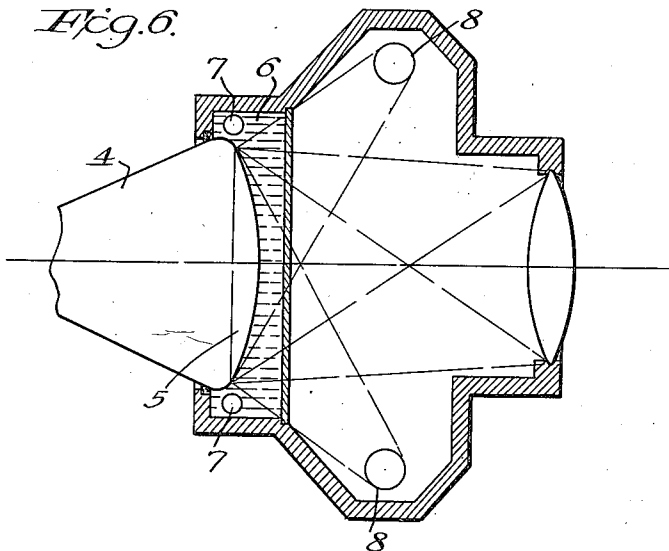
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IMAGE SCREEN FOR BRAUN TUBES

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Fig. 6.



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UNITED STATES PATENT OFFICE

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IMAGE SCREEN FOR BRAUN TUBES

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2 Claims. (Cl. 250-164)

The present invention relates to cathode ray tubes used for delineating television images, oscillograms and the like, and deals more particularly with an image screen adapted for rendering the delineated image visible in incident light or by projection.

Self-luminous image screens are normally used in Braun tubes, especially those embodying predominantly fluorescent materials. It is also known to make the screens of very finely distributed metal, for example very thin foils or metal gauze. These metal screens when bombarded by the cathode ray become very strongly locally heated, the heating depending on the intensity of the ray, so that they are suited for delineating television images. Both types of screens, including the fluorescent screen as well as the metal screen acting as a temperature responsive radiant body however, have the drawback that they possess a luminous power which is limited by the capacity of the cathode ray and the electro-optical network effect of the screen.

In accordance with the present invention a self-luminous screen is entirely avoided and an image screen is used which alters its optical properties (such as color, reflecting power or light transmissibility) under the influence of cathode ray bombardment, so that the television image will not appear as a luminously contrasty image but rather must when viewed, be lighted by an outside light source or by daylight. This use of an outside light source completely eliminates the lighting problem so that it is possible to do the viewing in undarkened rooms or to project (the images) in desired size either episcopically or diascopically.

The subject matter of the invention is described below and illustrated in the drawings, wherein:

Figs. 1-3 show a graphical representation of the behavior of such a screen.

Fig. 4 is a cross section through the screen.

Fig. 5 is a graphical representation of the relations between temperature and color of such a screen.

Figs. 6 and 7 show two embodiments for episcopic and diasopic projection.

In order to produce a variable color image screen, a coloring agent is used the color of which depends on the temperature and in respect of which the change of color occurs either suddenly or within a definite temperature range. Substances which are suitable for this purpose are: silver-mercury-iodide, copper-mercury-iodide, or

a mixture of both. The transition temperatures of these coloring agents lie between 40-120° and vary according to the mixture proportions used. Even the temperature range in which the change occurs may be more or less sharply defined by suitable mixing.

If the individual image point were heated only at the instant when the cathode ray bombards it, that is, if it shows a color change only during this short period, a very dull image would result; for, if the image point has the color corresponding to a given high temperature only during the image point interval and if during the entire remaining period it has the color corresponding to a lower temperature, then the eye would see a mixed color which would possess only a very small fragment of the heat color desired and which would be appreciably overbalanced by the cold color. The desideratum to be sought is that each image point should retain the color imparted to it by the cathode ray until shortly prior to the period in which the cathode ray strikes it anew, but nevertheless, prior to the instant when the fresh bombardment of the ray occurs, it should suddenly return to its starting value. This condition, in accordance with the invention may be attained by the use of materials which change their color suddenly in accordance with temperature and which as a result thereof are preeminently suited for the reproduction of black-white images.

Fig. 1 shows the temperature curve of a particle of the screen in relation to time. Such a screen is, during its operation, preheated to operating temperature *a*, e. g. by means of a separate heat source, so that a small temperature rise produced by the cathode ray will cause the color change to occur at temperature *b*. By suitably selecting the heat inertia of each screen particle the exponential temperature drop of the screen portions may be so adjusted that immediately after an image change *t* the screen portion will pass through the temperature at which the color change occurs, so that in this way a sudden and optimum color change will occur.

Such a screen may also be utilized for reproducing images having halftones if the relations of the time ranges during which the screen particles show one or the other color are altered. If for example, according to Fig. 2, during the first image change interval *t*₀, the temperature is raised to point *c*, the image point will appear in the high temperature color. If during the next bombardment the temperature is raised

only to d , then the image point will appear as a halftone to the eye if the time t_b be sufficiently small and finally, if the heating is very weak, say at point e , the image will have the basic color of the material.

A further method of producing halftone images consists in using materials the color change of which occurs in a greater temperature range (Fig. 3) so that all tonal values between the color values $a-g$ may be produced by the various cathode ray intensities and the thereby resulting varying degree of heating. In this case the image will always suffer a certain loss of contrast value because the temperature of the screen particles will drop exponentially during an image alternation. Nevertheless even here an optimum contrast value will be achieved if the drop is so proportioned that the light image screen portions again reach their normal temperature after an image alternation (Fig. 3).

In order to regulate the heat inertia of the screen portions to the above described extent, the heat insulation of the individual parts is suitably influenced. For example, as shown in Fig. 4, a loose intermediate layer 2 of quartz powder is disposed between glass support 1 and the image screen 3 thus improving the insulation of the image screen portions as between each other and their glass support. In order to decrease the quantity of heat insulation used the material may for example be embedded in a binder such as waterglass.

As discussed in the case of materials which change color suddenly it is also preferable in the case of materials which change color gradually to preheat the screen by separate heat sources. The screen is then brought to the temperature T_1 (Fig. 5) at which the color change starts so that the additional heating caused by the cathode ray governs the color of the image screen, this procedure starting at the lower kink in the color curve.

The maximum ray output is thereupon so adjusted that it effects an increase in temperature which extends to the upper kink of the color curve T_2 that is, the maximum excess temperature of the bombarded image point at a given time must be equal to the color change interval. This condition can be particularly easily attained by using Braun tubes of the supplementarily accelerated type and by regulating the supplementary accelerating voltages to bring the maximum prevailing ray output up to the desired value. The necessary preheating of the image screen may be effected by heated fluid baths as shown in Fig. 6. Here 4 represents the Braun tube, 5 the image screen and 6 a water bath heated by immersion heater 7. When dealing with an arrangement intended for projecting the images it is preferable to use the light source 8, employed

for projection, for heating the screen surface also.

In the case of a coloring agent in which a dark coloration represents a high temperature and a light coloration a low temperature, it is necessary to make the image impulses negative at the Braun tube since in the case of such colorations the image occurs in reversed relation on the image screen.

Another embodiment of the invention, shown in Fig. 7, involves an arrangement for diascopic projection and uses for that purpose an image screen of which the luminous transparency varies with the energy of the incident ray. For this purpose the glass bottom 9 of a Braun tube 10 is coated with a transparent and conducting layer 11 e. g. of cadmium oxide. Upon this layer is disposed a mosaic of double refracting crystals 17. For this purpose small crystals of Rochelle salt (sodium potassium tartrate), quartz, or similar substances are suitable. It is preferable to allow these crystals to become deposited directly on the bottom of the tube from out of a mother liquor poured into the Braun tube. These tiny crystals thereby orient themselves in astonishing agreement with respect to their electrical axes and at the same time make good contact with the metallic support. If such a mosaic screen is bombarded by a cathode ray the crystal surfaces directed away from the metallized coating become negatively charged with respect to the metal coating and produce an electrical field in the crystals the strength of said field depending upon the cathode ray intensity. In this manner the crystal structure becomes double refracting to an extent corresponding to the incoming image signal. By suitable crystal-optical arrangement such an image screen may be used for transparency projection. Fig. 7 shows a projection wall 12 which is illuminated by light source 13. The light passes through Nicol prism 14 acting as polarizer, then the image screen 17, and is reflected at the black glass plate 15 so as to illuminate the projection wall 12. The lens 16 throws the crystal mosaic on the image screen.

I claim:

1. A cathode ray device having a light transmitting image screen comprising a support, a layer of screen material including a mercury-iodide and an intermediate layer of poor heat conducting material between said support and said layer of screen material.

2. A cathode ray device having a non-luminous light transmitting image screen comprising a support, a layer of screen material including copper-mercury-iodide and an intermediate layer of poor heat conducting material between said support and said layer of screen material.

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